7th Joint Session of the EMEP Steering Body and the Working Group on Effects
14-18 September, 2021

POP pollution assessment with focus on PAHs and long-term trends

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MSC-E
МСЦ-В

NILU Norsk institutt for luftforskning Norwegian Institute for Air Research

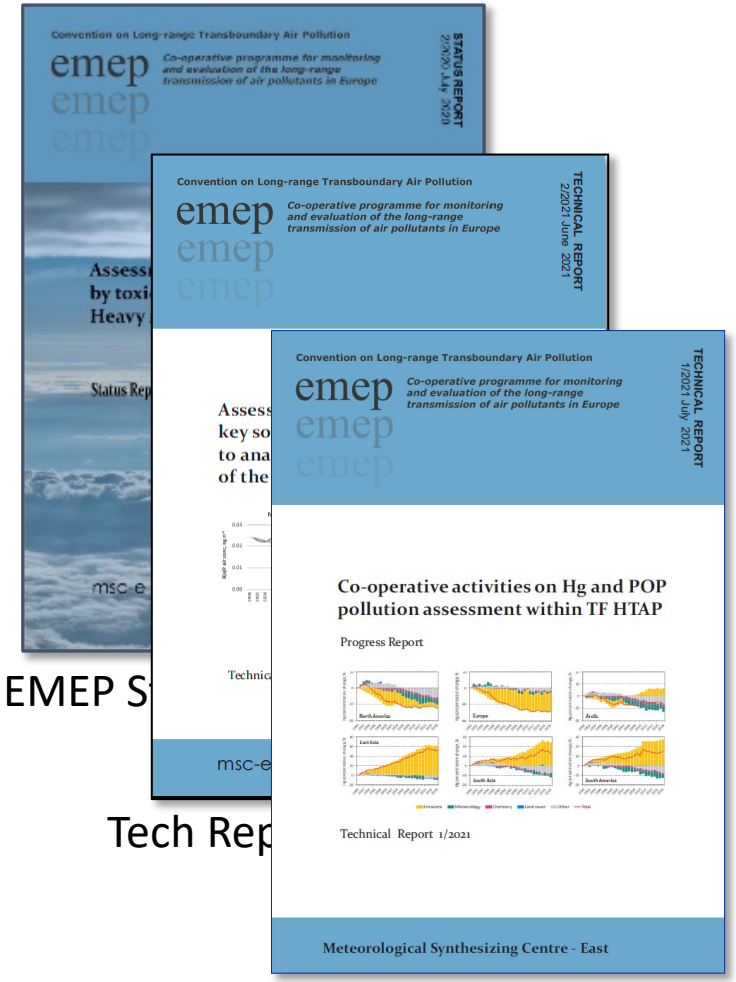
CEIP umweltbundesamt

IOŚ-PIB

Outcome of activities on POPs in 2021

Main topics :

- ***Operational activities***
  - Emissions of POPs in the EMEP region (CEIP)
  - POP monitoring in the EMEP region (CCC)
  - Model assessment of POPs (PAH, PCDD/F, PCB, HCB) pollution for 2019 (MSC-E)
- ***Research activities***
  - BaP/PAH pollution case study for Poland
  - Model assessment of PAH long-term trends and population exposure in EMEP region
  - Attribution of long-term changes of global scale POP pollution (TF HTAP)
- ***Co-operation with international organizations***
- ***Plans on further activities***



EMEP S

Tech Rep

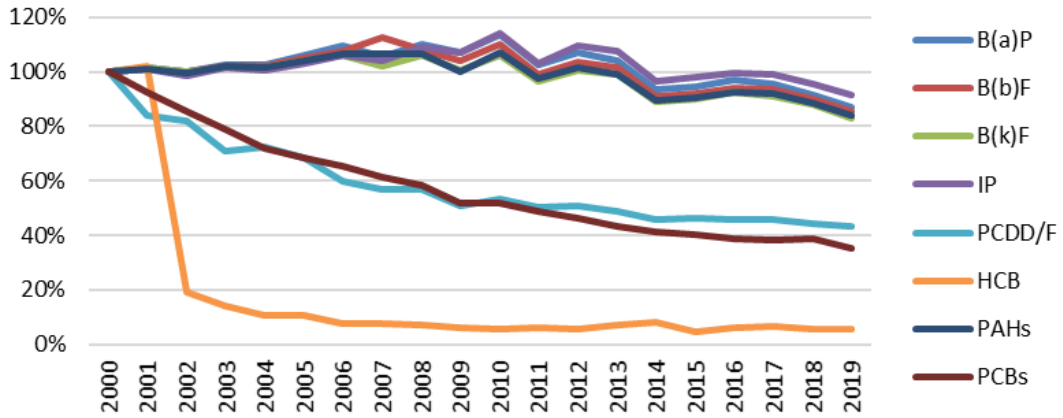
Tech Report on Hg/POP global trends (2021)

www.msceast.org **(MSC-E),** www.ceip.at **(CEIP),** www.nilu.no/projects/ccc/ **(CCC)**

POP emission data for modelling (CEIP)

Activities:

- Analysis and gap-filling of reported POP emission data (CEIP)
- Expert estimates and gridding of POP emissions for most recent year (CEIP)
- Preparation of gridded emissions for analysis of long-term trends (MSC-E)
- Compilation of global emission data (MSC-E)

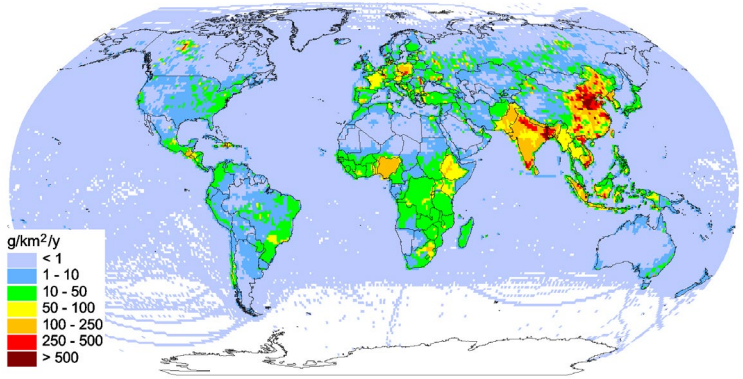


Decrease of POP emissions in EMEP domain (western part)

PAHs – 16%, PCDD/Fs – 60%, PCBs – 65%, HCB – 95%

Challenges:

- Reduction of uncertainties in reported POP emissions (e.g. eastern part of EMEP domain)
- Development/refinement of global POP emission inventories (in co-operation with experts under TF HTAP)



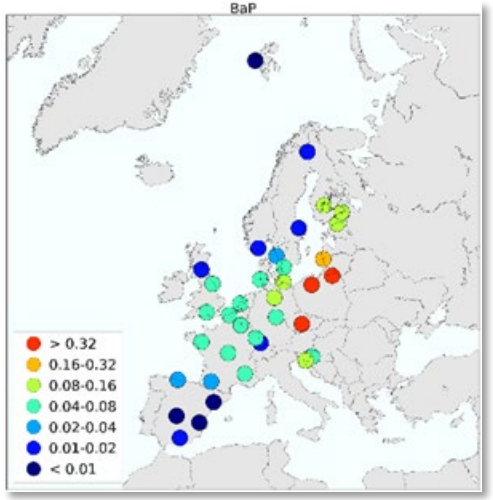
Gridded global B(a)P emission inventory

(PKU-FUEL project, Beijing University)

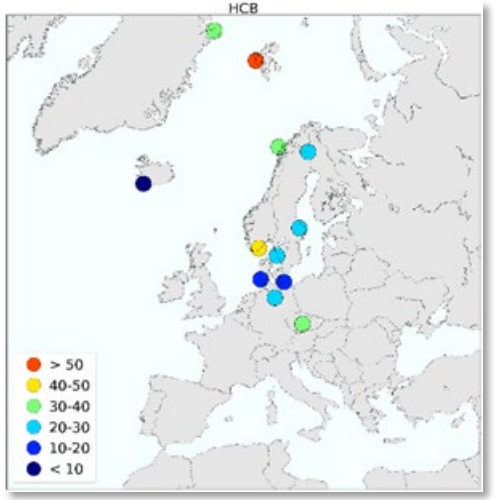
Monitoring of POP pollution levels (CCC)

Activities:

- Collection and analysis of POP measurements of the EMEP network (CCC)
- EMEP passive sampling campaigns for selected POPs (CCC)
- Compilation of POP measurements from other databases/networks (MSC-E)



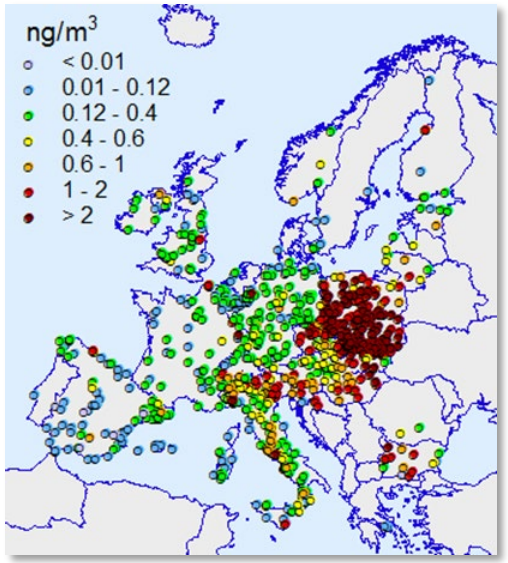
B(a)P in air (2019), ng m^{-3}



HCB in air (2019), pg m^{-3}

Challenges/recommendations:

- Laboratory intercomparisons for POPs
- Reduction of uncertainties of POP air/precipitation measurements



B(a)P in air observed at EEA AQ e-Reporting stations (2019)

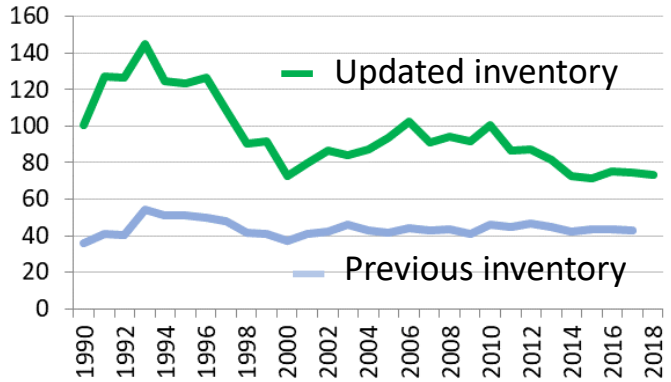
PAH assessment: case study on B(a)P/PAH pollution in Poland

Joint research for Spain, France, and Poland to improve PAH pollution assessment (TFMM)

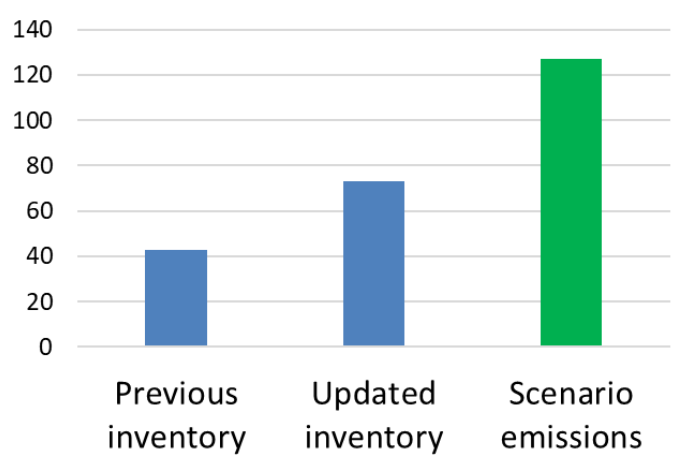
Program of the study (2020-2021):

- Model assessment of PAH in Poland involving detailed national emission and monitoring data
- Model simulations with the previous and updated national PAH emissions inventory
- Experimental model simulations using scenario of B(a)P emissions
- Estimation of exceedances of B(a)P air quality guidelines
- Inter-comparison of GLEMOS and GEM-AQ model results for B(a)P

B(a)P emissions in PL (t y^{-1})



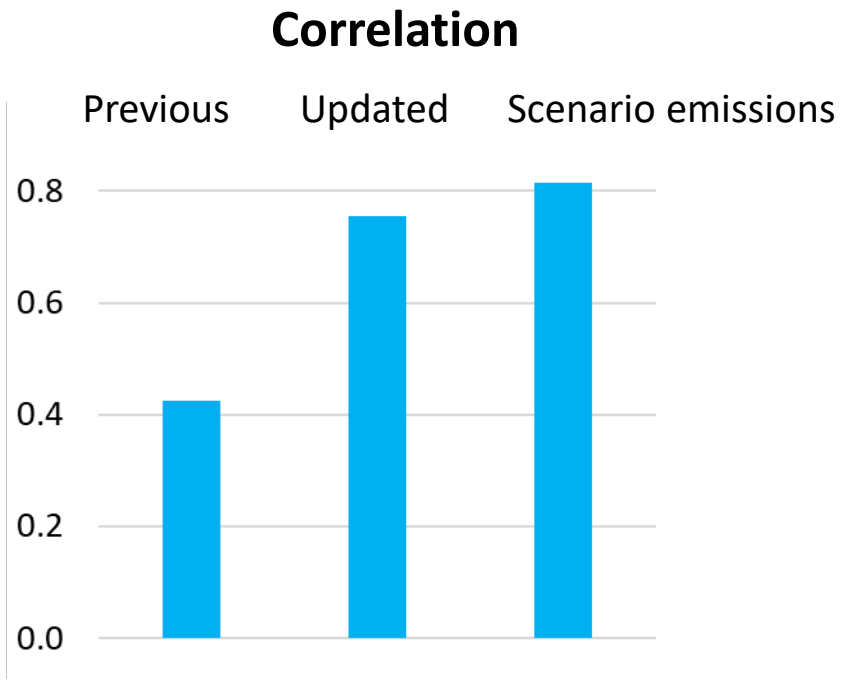
B(a)P emission in 2018 (t y^{-1})



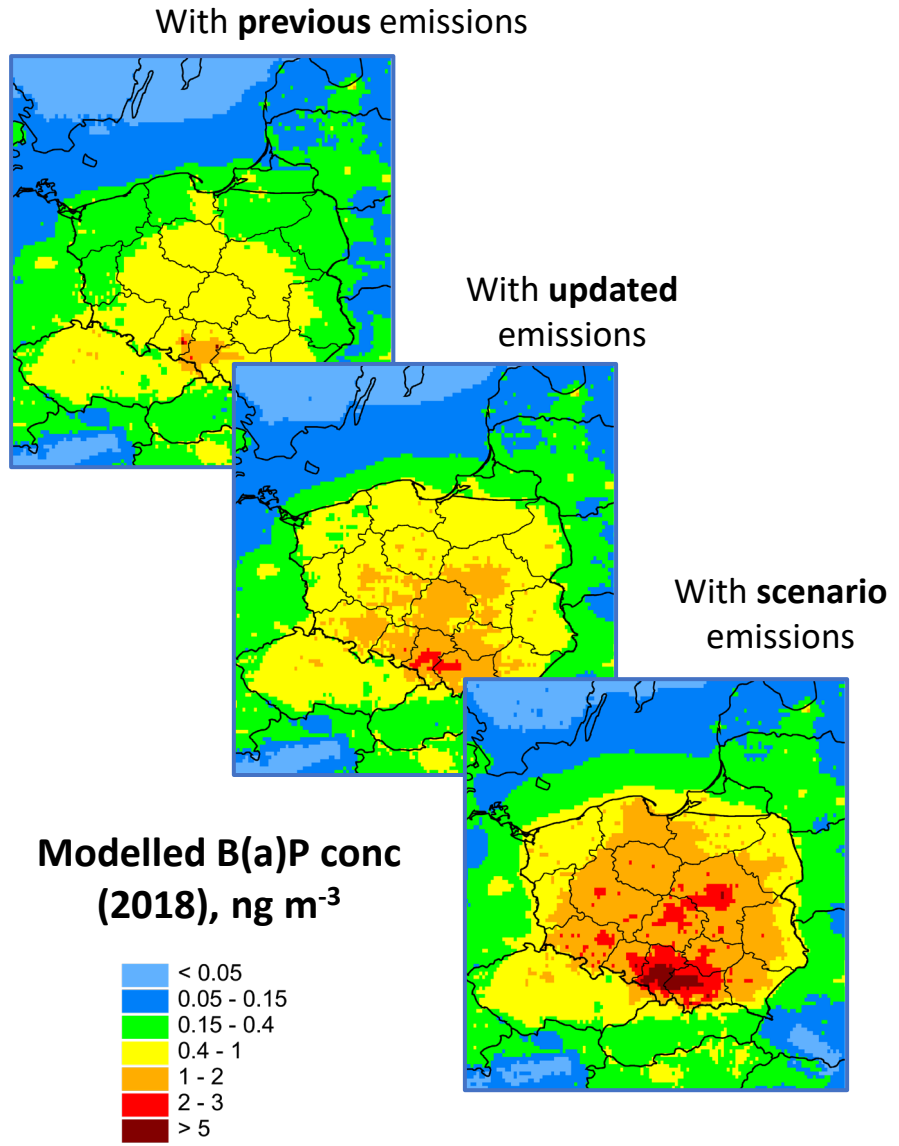
Modelled vs observed B(a)P pollution levels in Poland

Comparison with data of Background Rural + Suburban stations:

- Decrease of model **bias** from -64% to -28%
- Increase of **correlation** from 0.42 to 0.82
- Increase of **Factor of 2** parameter from 30% to 70%



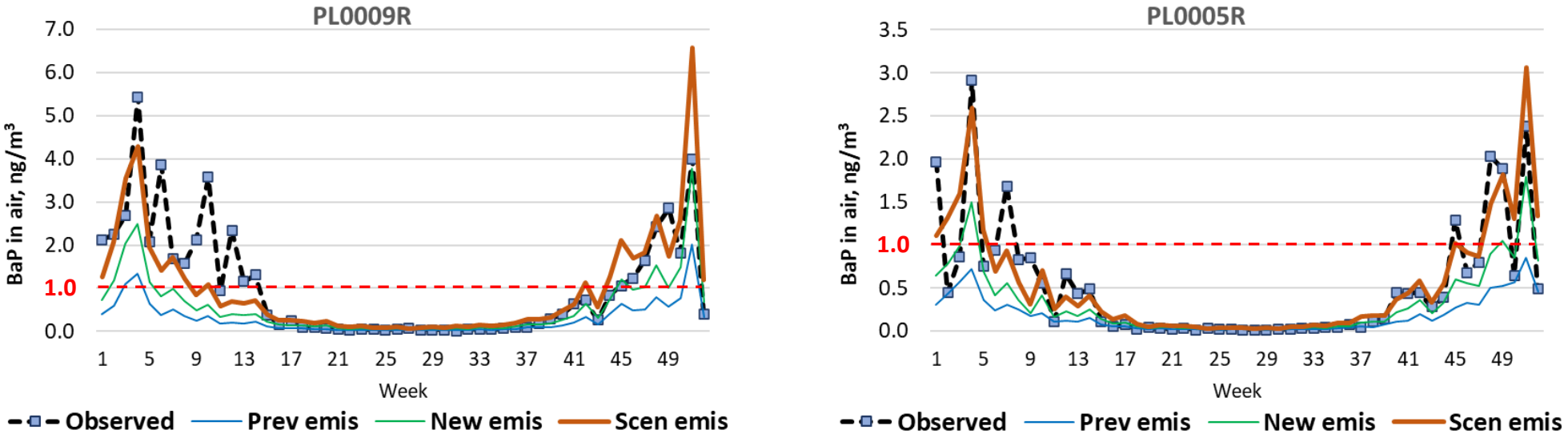
56 stations of EMEP and EEA networks (2018)



Modelled vs observed B(a)P pollution levels in Poland

Comparison with data of EMEP stations in Poland:

- Decrease of model **bias** from ~ **-70%** (previous emissions) up to ~ **-5%** (scenario emissions)



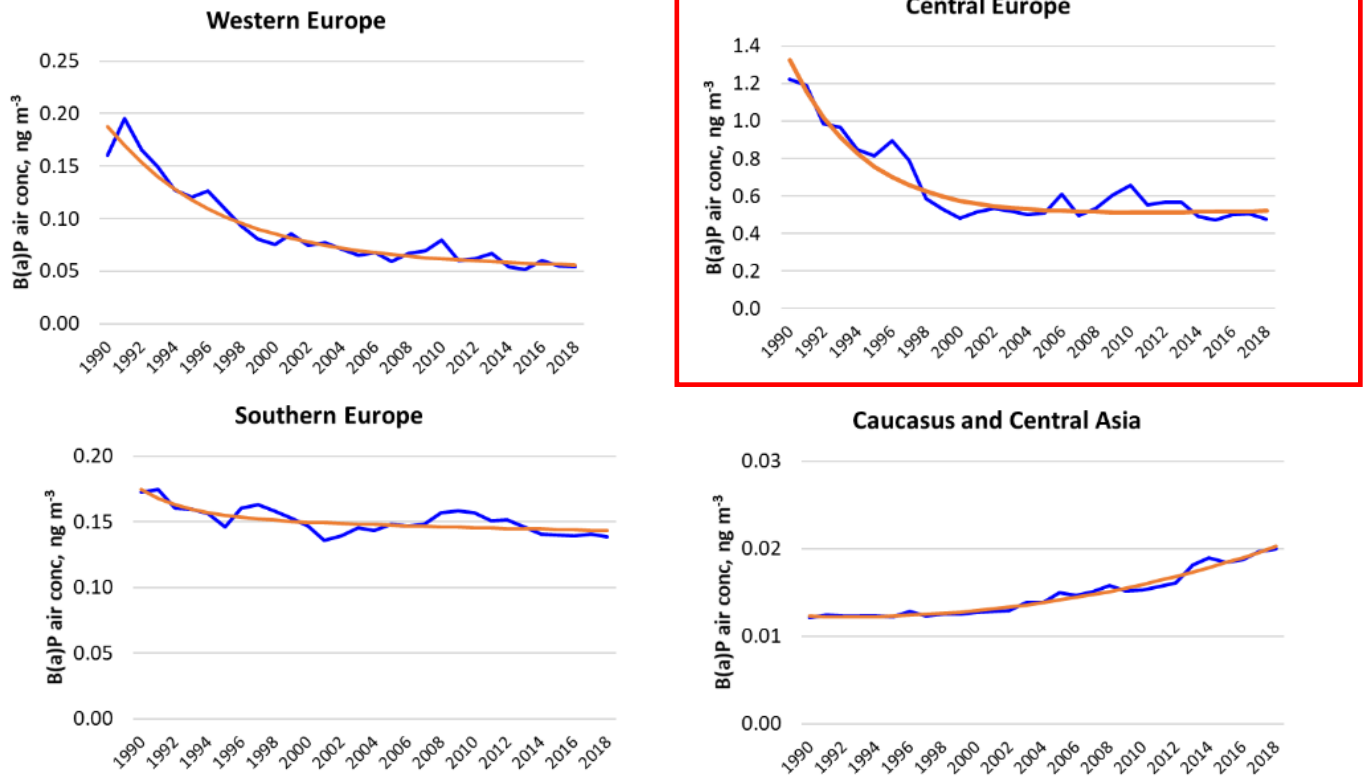
EU target level for B(a)P 1.0 ng m^{-3}

- Updates of national PAH emission inventory allowed to noticeably improve B(a)P model assessment results
- Model simulations indicate significant exceedances of EU target level (especially in winter time) associated with the effect of Residential Combustion emissions

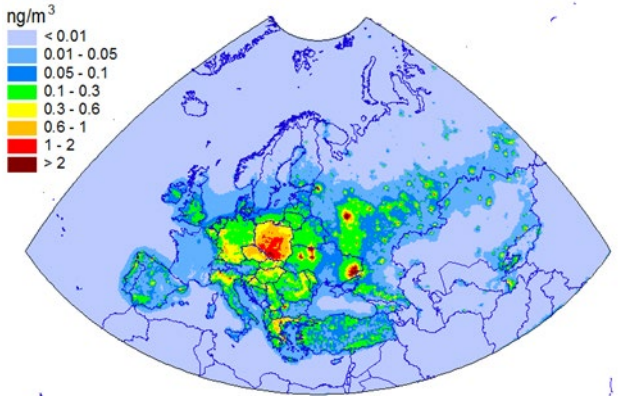
Long-term changes of PAH pollution in EMEP countries

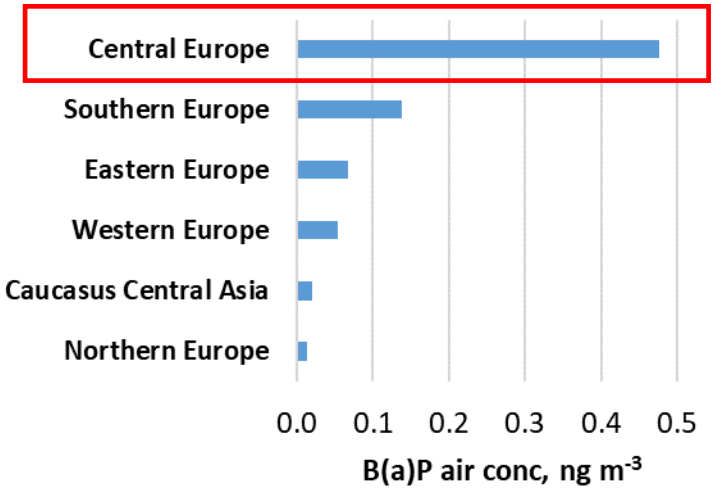
Model estimates of B(a)P pollution trends (1990-2019):

- Significant decrease in Western Europe (65%)
- Small decrease/lack of changes in Central, Southern Europe after 2000
- Increase in Caucasus and Central Asia



Modelled B(a)P concentrations (2019)



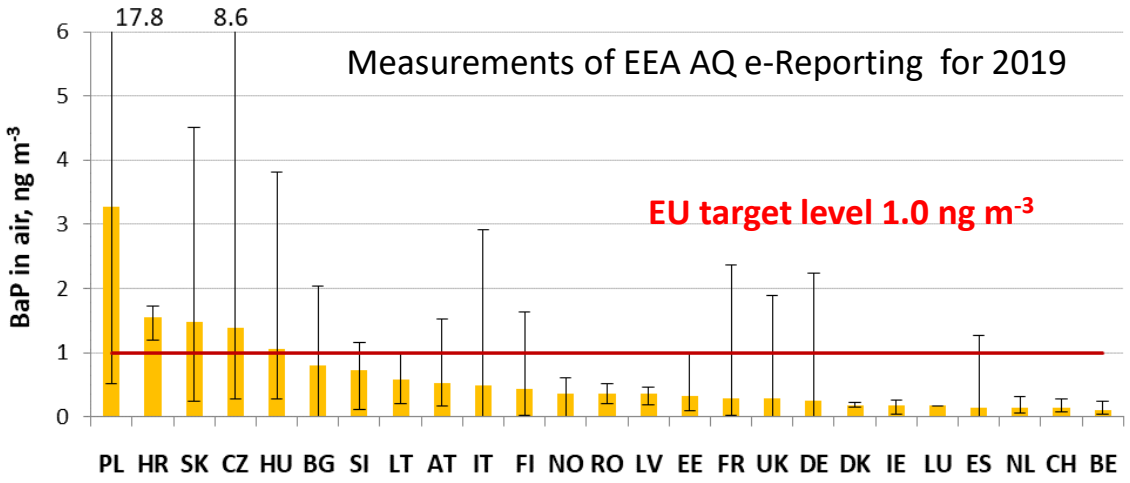


Long-term changes of B(a)P concentrations (absolute values)

PAH pollution and population exposure

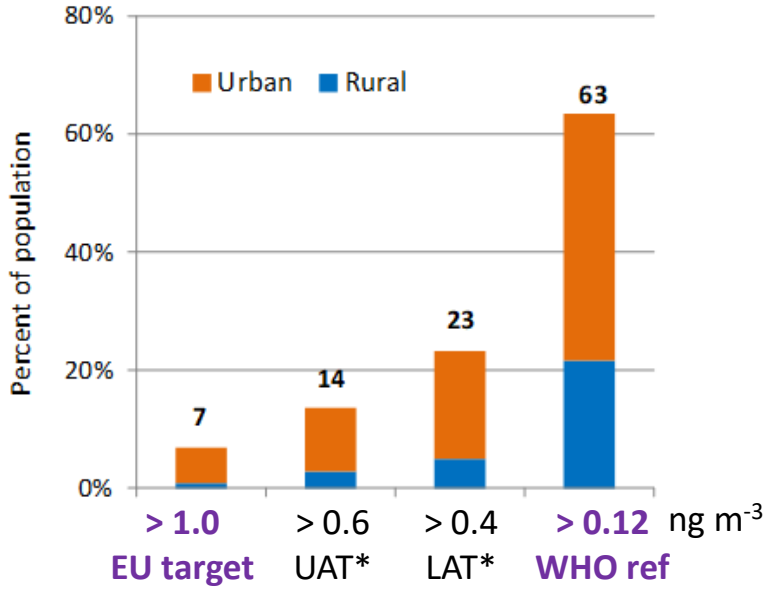
Observed and modelled B(a)P levels vs EU and WHO limits (2019):

- Exceedances of air quality guidelines still exist in some of EMEP countries (e.g. Central Europe)
- Most of exceedances of EU/WHO limits took place in urban areas
- In 2020, EC announced revision of EU air quality standards, including B(a)P, towards stricter guidelines recommended by WHO



Observed B(a)P concentrations vs EU target level

Population in areas with exceeded B(a)P limits

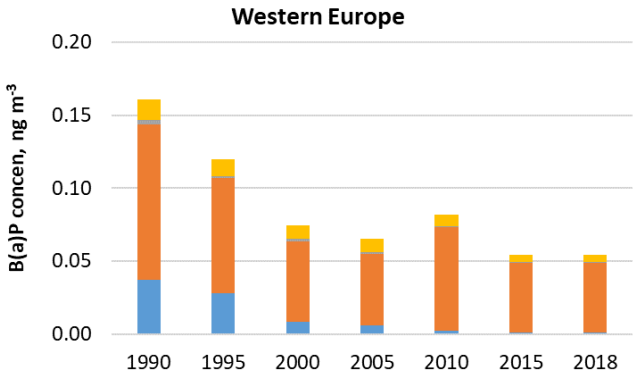


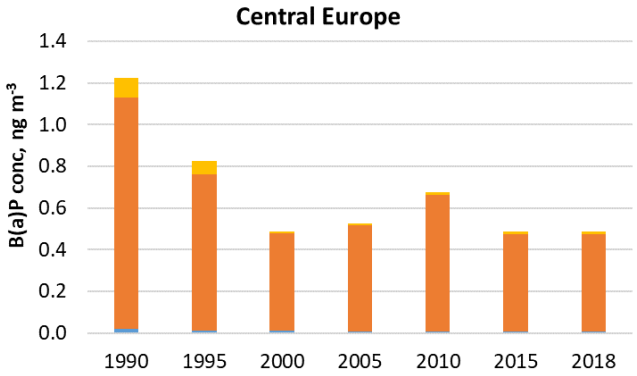
* UAT/LAT – Upper/Lower Assessment Threshold according to EU Air Quality Directive

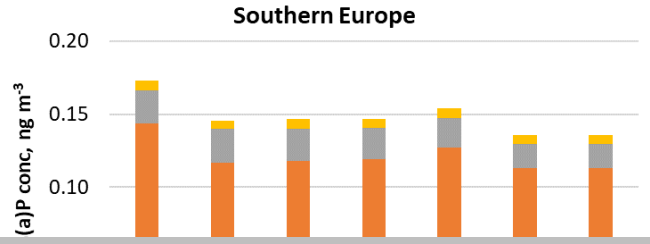
Key source-categories of PAH pollution in EMEP countries

Model estimates of key sectors contributions and their long-term changes:

- Residential combustion sector is dominating in all the sub-regions
- Decline of Industry sector contribution in 1990s (e.g. Western Europe)
- Considerable contribution of Agriculture sector in Southern Europe



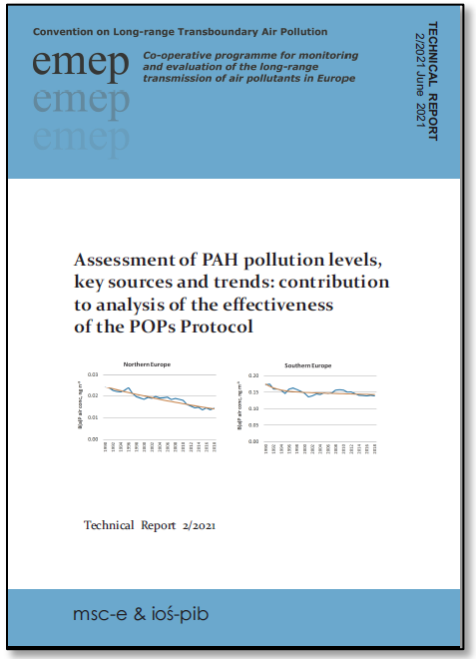




Key emission sectors

Industry

Agriculture



Tech Report on PAHs (2021)

Results of B(a)P/PAH pollution assessment were discussed at the meeting of TF Health (11 May, 2021) and are included in the TF Health/B(a)P group's report

Further activities on PAHs: multi-model study of B(a)P pollution

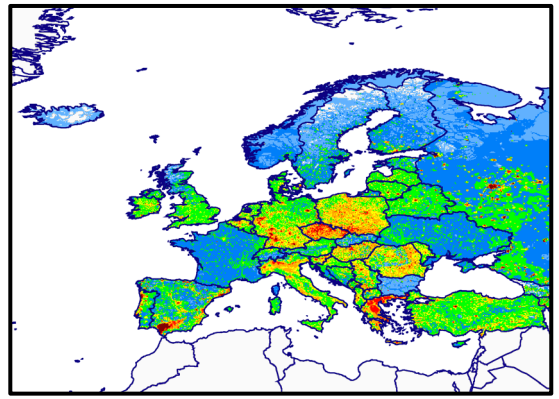
Contribution to EuroDelta-Carb project on PM/BC (TFMM)

Objectives:

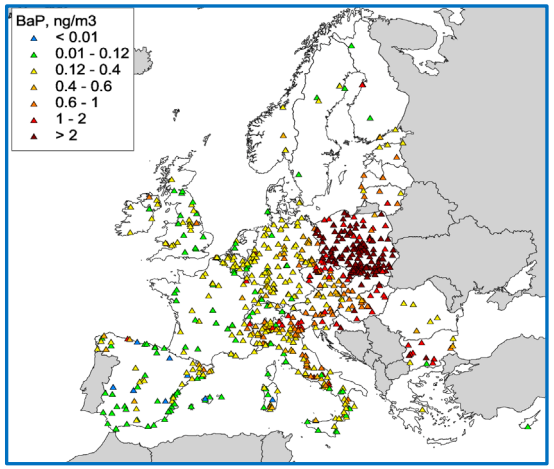
- Model assessment of B(a)P pollution levels and exceedances of air quality guidelines for 2017-2018
- Contribute to analysis of consistency of Residential Combustion emissions of PAHs/PM
- Analyzing relationship between B(a)P and PM transport and fate (including PM components – OC, EC)
- Use of EMEP and EEA AQ e-reporting B(a)P measurements

Modeling groups:

Institution	*Model*	Experts
EMEP/MSC-E	GLEMOS	Alexey Gusev
INERIS (France)	CHIMERE	Augustin Colette
FMI (Finland)	SILAM	Rostislav Kouznetsov, Evegeny Kadantsev
CIEMAT (Spain)	CHIMERE	Marta Garcia Vivanco
ENEA (Italy)	MINNI	Mihaela Mircea, Ilaria Delia, Mario Adani



Model domain and B(a)P emissions (2018)



B(a)P measurements (EMEP, EEA, 2018)

Analysis of long-term trends of global POP pollution

Attribution of trends to various factors (co-operation with TF HTAP): preliminary results

Motivation:

- Analise long-term pollution changes in the EMEP and other regions
- Isolate the effect of regional emissions reduction from other factors

Factors analyzed :

- Changes of regional POP emissions
- Long-range transport from other regions
- Variation of meteorological and surface conditions
- Changes of atmospheric reactants concentrations

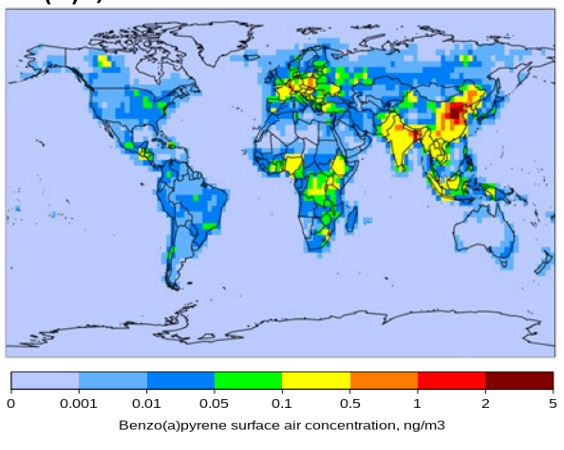
Pollutants :

selected PAHs (B(a)P, Fluoranthene)

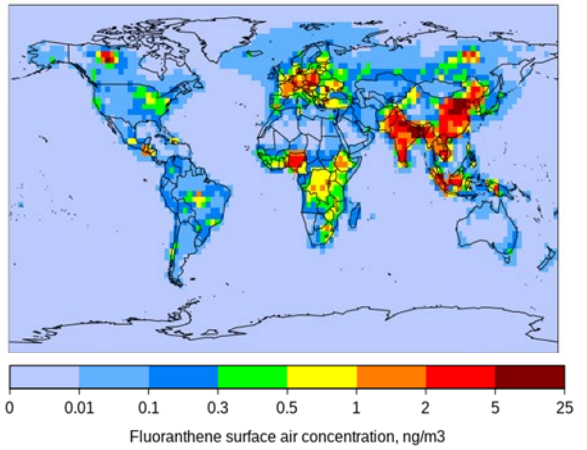
Emissions :

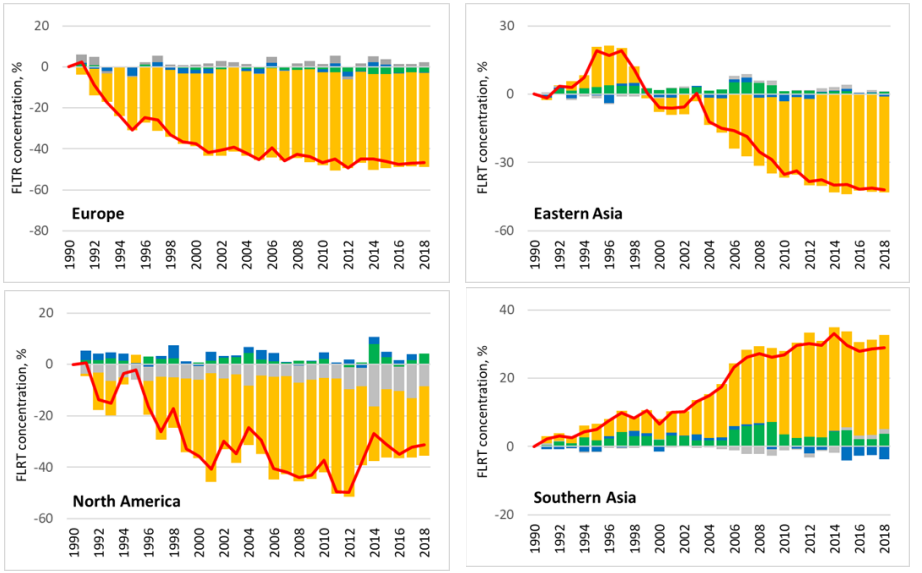
global PAH emission inventory of PKU-FUEL project (China)

B(a)P, 2018

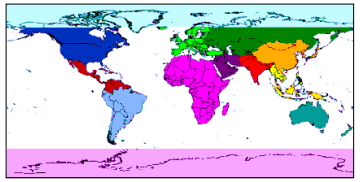


Fluoranthene, 2018





HTAP regions



Scientific co-operation on POP pollution assessment

TF HTAP/MSC-E Workshops on POPs (April 15, 2021)

Objectives :

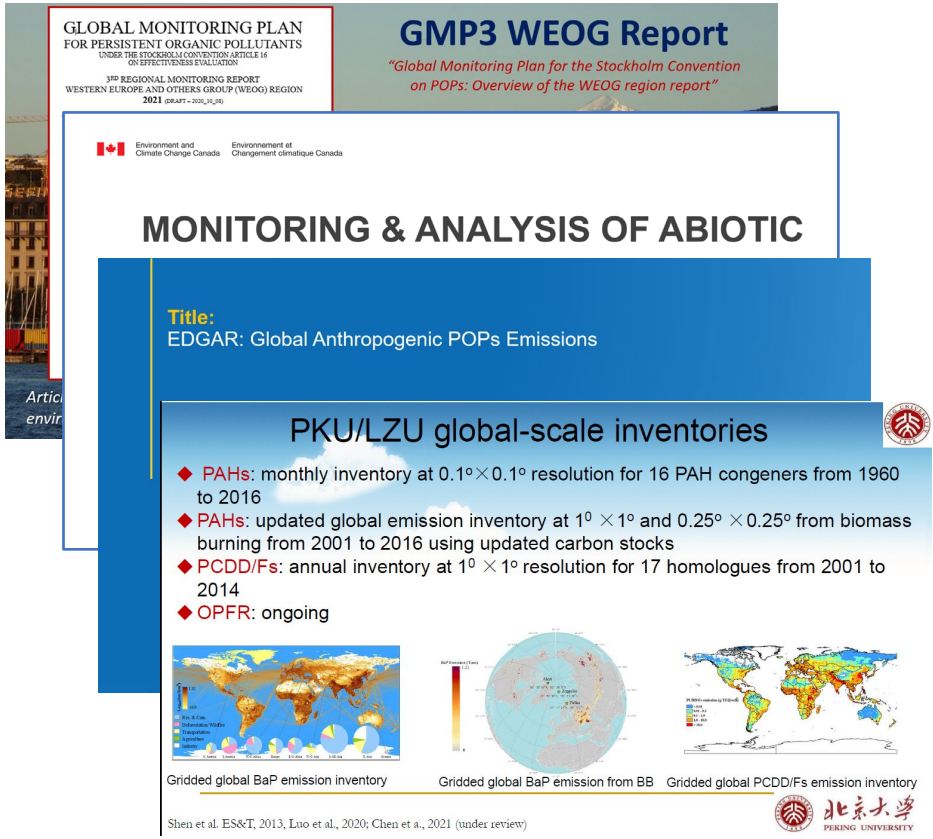
- Review of progress made by various international organizations in the assessment of POP pollution
- Initiate cooperative activities to enable TF HTAP better contribute to possible review of the effectiveness and sufficiency of the POPs Protocol

Participants :

81 experts from AMAP, Stockholm Convention, EMEP, other national organizations

Topics discussed :

- Analysis of Trends in measured/modelled pollution levels of POPs and Chemicals of Emerging Concern (CECs)
- POP emission inventories: Compilation, Intercomparison, and Evaluation
- Model Intercomparison for combustion related POPs (e.g. primary/secondary emissions, S/R relationships, impact of biomass burning/wildfires)
- …



More information on the workshop:

www.htap.org (TF HTAP)

Chemicals of Emerging Concern (CECs)

Monitoring of CECs in EMEP region (CCC/NILU) :

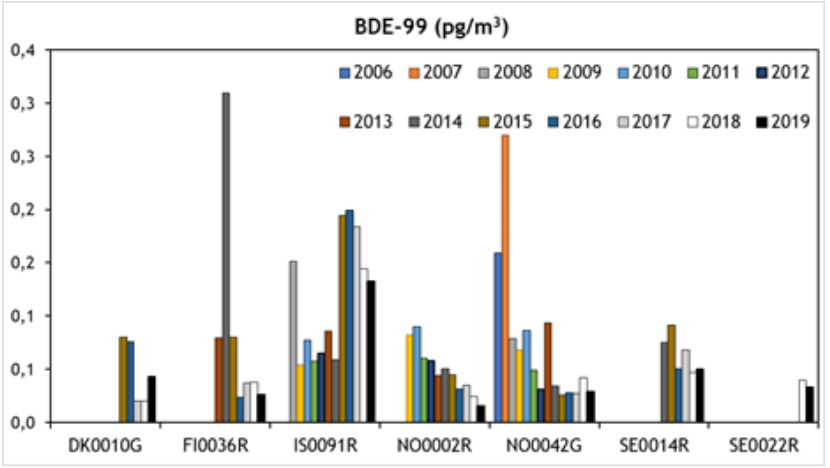
- CECs may have similar impacts on human health and ecosystems as the legacy POPs
- Some of CECs (e.g. PBDEs, SCCPs, PFAS) are monitored at 8 EMEP stations

Evaluation of Baltic Sea pollution by CECs for HELCOM :

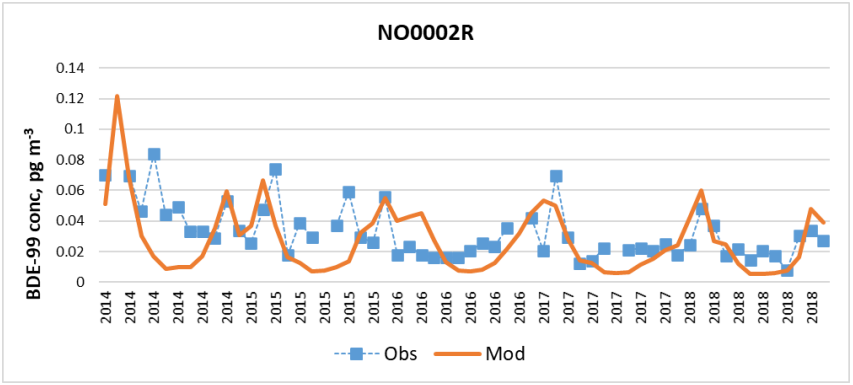
- Considered pollutants: PFOS, PBDEs, SCCP, PCN, PeCBz, HBCDD
- Pilot study of PBDE atmospheric input to the Baltic Sea (based on the contract between MSC-E and HELCOM)

HM/POP/CEC session of TFMM (May, 2021) :

- Proposal of workshop on new contaminants incl CECs to collect information on measuring methods, multi-media modelling in co-operation with TF HTAP



Long-term measurements of BDE-99 (2006-2019)



Observed and modelled BDE-99 concentrations

Directions of further work

Proposals for the work-plan 2022-2023

- **Research activities**
  - Multi-model analysis of B(a)P pollution in 2017/2018 in framework of TFMM EuroDelta-Carb project
  - Analysis of long-term changes and source-receptor relationships on global/regional scale in co-operation with TF HTAP (combustion-related POPs)
  - Continuation of case study on B(a)P pollution in the EMEP countries (e.g. Spain, Poland)
- **Co-operation**
  - Data exchange with TF Health on B(a)P/PAH concentration and exceedances of target values to assess population exposure
  - Co-operation with international organizations (HELCOM, Stockholm Convention, AMAP)
  - Contribution to the EU EEA assessment of B(a)P pollution in the EU countries